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Notes on the Japanese Agromyzidae (Diptera), 3 *Liriomyza*-miners on *Artemisia* spp. (Asteraceae)[1)]

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Abstract Seven mugwort (*Artemisia* spp.) miners of the genus *Liriomyza* are recorded from Japan; of these, one species, *L. vitrimentula*, is described as new to science, and four species, *artemisiae* SPENCER, *artemisicola* DE MEIJERE, *ptarmicae* DE MEIJERE and *yasumatsui* SASAKAWA, are newly added to the fauna.

Key words: Agromyzidae; Diptera; *Artemisia*; *Liriomyza*; new species; Japan.

Ten species of the genus *Liriomyza* MIK: six monophagous, *artemisiae* SPENCER, *artemisicola* DE MEIJERE, *demeijerei* HERING, *dracunculi* HERING, *gudmanni* HERING and *katoi* SASAKAWA, in addition to two oligophagous, *ptarmicae* DE MEIJERE and *togata* MELANDER, and two polyphagous, *strigata* (MEIGEN) and *trifolii* (BURGESS), have been known as the mugwort (*Artemisia* spp.) miners in the world (SPENCER, 1990). In Japan, it seems likely that three mugwort miners, *L. artemisiae*, *artemisicola* and *ptarmicae*, are common, as *L. katoi* occurs. However, *L. trifolii*, known as a pest of the cultivated chrysanthemum, tomato, etc. in Japan (SASAKAWA, 1993), has not been observed to occur on the mugwort. Two species, *L. pusilla* (MEIGEN) (oligophagous but most frequent on Astereae) and *yasumatsui* SASAKAWA (1972, host unknown), were joined newly in a group of mugwort miners, as a result of confirmation of their larval feeding habit. An additional miner, *L. vitrimentula*, which is allied to *katoi*, is described as new to science.

Although the species of *Liriomyza* appear to be classified by the external characters, such as color and chaetation, the separation is justified by the two divergent types of male genitalia primarily as given in the key, couplet 1. Namely, the presence of the stout spines on inner side of the epandrium above surstyli in addition to those on the posteroventral corners, the tubular form of the distiphallus and the distinct separation of distal phalli into meso- and distiphallus, are considered apomorphic. On the contrary, the coloration is so variable in the degree of darkness that it may be unable to specify as one of the characteristics. For example, the third antennal segment of *L. ptarmicae* is either entirely yellow or distinctly darkened; mesopleuron of *artemisiae* is provided with only a small brown spot at middle of ventral margin or with a dark band on ventral half.

The holotype is deposited in the collection of Entomological Laboratory, Kyoto

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Prefectural University, Shimogamo, Kyoto (KPU). Abbreviations for figures are the same as those described in the previous paper.

Key to the Japanese mugwort miners of *Liriomyza*

1. Epandrium without spines at middle of inner side; phallus with a pair of narrow sclerites on lateral sides between basi- and mesophallus 2
— Epandrium with a pair of stout spines at middle of inner side above surstyli; phallus without isolated lateral sclerites before base of mesophallus 4
2. Mesonotum shining black 3
— Mesonotum mat, densely gray-dusted black; distiphallus shorter than mesophallus ..... *L. artemisicola* DE MEIJERE
3. Distiphallus indistinctly separated from mesophallus and distinctly longer than that; pupation out of leaf-mine..... *L. pusilla* (MEIGEN)
— Distiphallus tightly fused with mesophallus and subequal to the latter in length; pupation in leaf-mine..... *L. artemisiae* SPENCER
4. Distiphallus bulbous, connected with mesophallus 5
— Distiphallus tubular, distinctly separated from mesophallus..... ..... *L. yasumatsui* SASAKAWA
5. Third antennal segment with pile of normal length; distiphallus indistinctly separated from mesophallus 6
— Third antennal segment with conspicuously long, white pile; distiphallus fused with mesophallus ..... *L. ptarmicae* DE MEIJERE
6. Surstylus short, with a very long spine on tip; phallus as in Fig. 6 .... *L. vitrimentula* n. sp.
— Surstylus long, usually with a minute spine in addition to a distinct apical one; phallus as in Fig. 7 ..... *L. katoi* SASAKAWA

1. *Liriomyza pusilla* (MEIGEN)

(Fig. 1)

Agromyza pusilla MEIGEN, 1830, 185.
Agromyza fasciola MEIGEN, 1838, 204; SASAKAWA, 1961, 398 (as *Liriomyza*).

This is a highly oligophagous leaf miner on *Bellis* and *Aster* spp., etc. in Europe; in Japan it occurs commonly on both *Artemisia* and *Kalimeris* spp.

The male genitalia are characteristic in having the narrow separation between meso- and distiphallus, and the former is distinctly shorter than the latter.

Specimens examined. HONSHU—2 ♂, from puparia, 6. VI. 1980 on *Kalimeris yomena* KITAM., Shimogamo, Kyoto, emerged 13. VI. 1980 (M. SASAKAWA); 3 ♂ 2 ♀, from larvae, 25. VIII. 1989 on *Artemisia princeps* PAMP., Sugikitamachi, Hirakata, Osaka Pref., emerged 10. IX. 1989 (M. SASAKAWA). KYUSHU—3 ♂, from larvae on *Aster* sp., Kagoshima, Kagoshima Pref., emerged 2. V. 1956 (M. SASA-

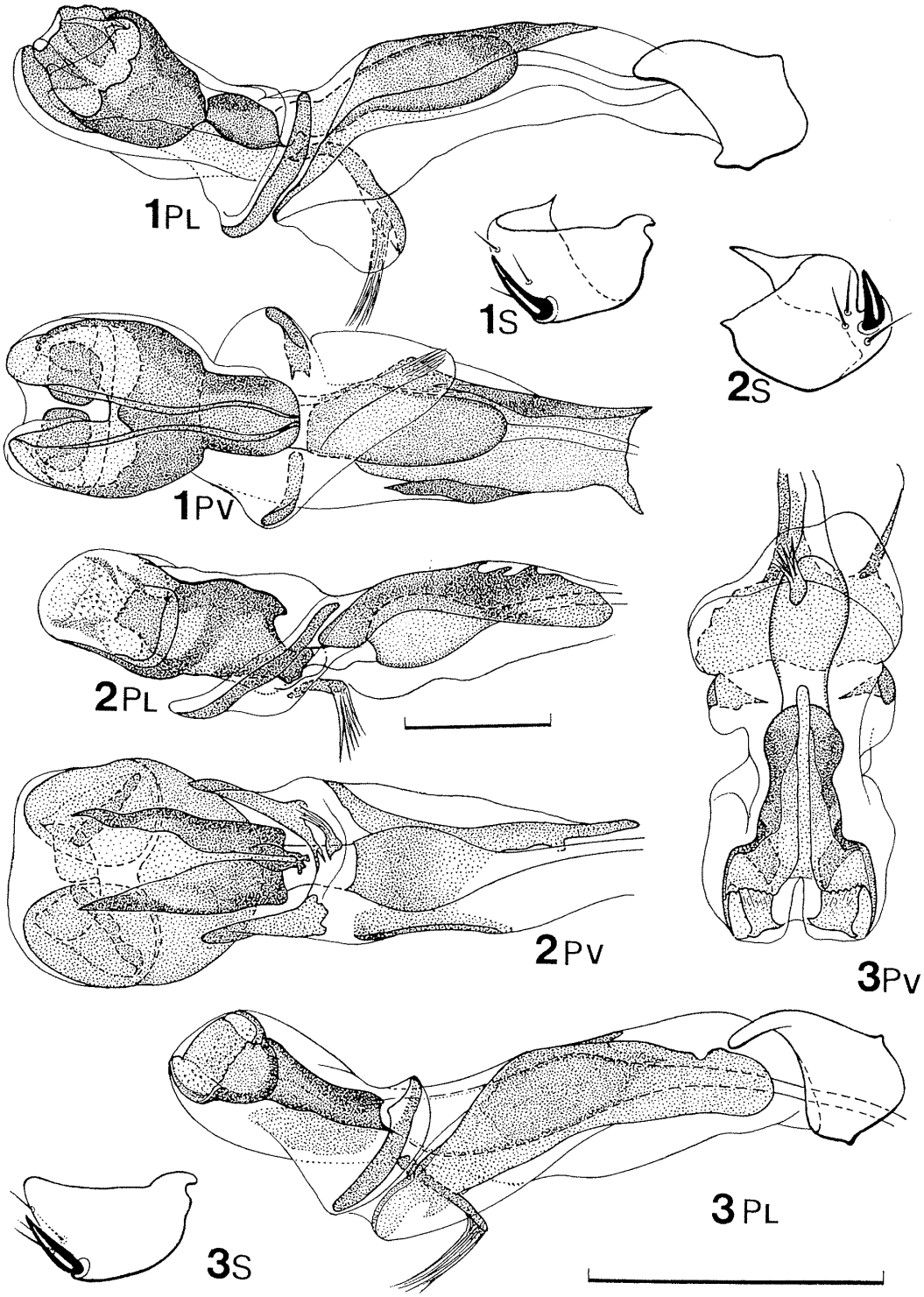

Fig. 1. *Liriomyza pusilla* (MEIGEN), phallus (PL, PV) and surstylus (S) of male genitalia. [Fig. 2PL is different in magnification from others.]
Fig. 2. *Liriomyza artemisiae* SPENCER.
Fig. 3. *Liriomyza artemisicola* DE MEIJERE.

KAWA); 47 ♂ 83 ♀, from larvae, 20. IV. 1956 on *Artemisia* sp., Nishinakama, Amami-Ohshima, Amami Is., emerged 3-10. V. 1956 (M. SASAKAWA).

Distribution. Europe; Japan (Honshu, Kyushu); Taiwan.

2. *Liriomyza artemisiae* SPENCER

(Fig. 2)

Liriomyza artemisiae SPENCER, 1981, 213.

This is a leaf miner of *Artemisia* spp.; pupation takes place in the leaf-mine, differing from other *Artemisia*-miners.

Following variations in coloration are seen in the specimens examined: *vti* growing at edge of yellow area but *vte* on black area of vertical angle; third antennal segment dark orange (*not* darkened on dorsal side); mesopleuron only with a small brown spot at middle along ventral margin in male, while brown on about half of ventral side in female; sternopleuron (♂, ♀) with dorsal margin distinctly yellow and *stpl* on yellow area; legs with coxae and femora largely yellow, the former brown at base and the latter with brown striations on dorsal side, tibiae and tarsi dark brown; male T6 yellow, with a small, pale brown spot at middle; T3–5 with posterior margins linearly yellow.

Frons 1.5 times as wide as eye in female and parafrontalia distinctly projecting above eye in profile; wing length 1.55 mm in male, 1.4–1.75 in female.

Puparium. Pale yellowish brown, 1.8 mm in length; mandibles each with two teeth; anterior spiracles knob-like, each with 6–8 bulbs; posterior spiracles small, slightly longer than anterior ones, each with 3 bulbs; cuticular processes in 6–7·2–3 rows on lateral side of A2–6.

Specimens examined. HONSHU—1 ♀, from larva on *Artemisia princeps* PAMP., Shimogamo, Kyoto, emerged 8. IX. 1955 (M. SASAKAWA); 1 ♀, from larva, 21. X. 1991 on *Artemisia princeps*, Oiwa, Kyoto, emerged 28. XI. 1991 (T. IMURA); 1 ♂, from larva, 16. X. 1992 on *A. princeps*, Kamigamo, Kyoto, emerged 23. X. 1992 (T. IMURA).

Distribution. U.S.A.; Japan (Honshu). New to Japan.

3. *Liriomyza artemisicola* DE MEIJERE

(Fig. 3)

Liriomyza artemisicola DE MEIJERE, 1924, 142; HENDEL, 1931, 209; SPENCER, 1976, 232.

This species has the mat, densely gray-dusted, black mesonotum. Following variations are seen in the specimens examined: head with black part of dorsal postorbit extending only to base of *vte*; third antennal segment entirely yellow (*not* brownish distally); mesopleuron only brown on ventral 1/3 (*not* 1/2) and with 1 or 2 dorsally directed setulae; wing length 1.3–1.4 mm (*not* 1.5–1.9). Male genitalia are characteristic in the structure of distiphallus.

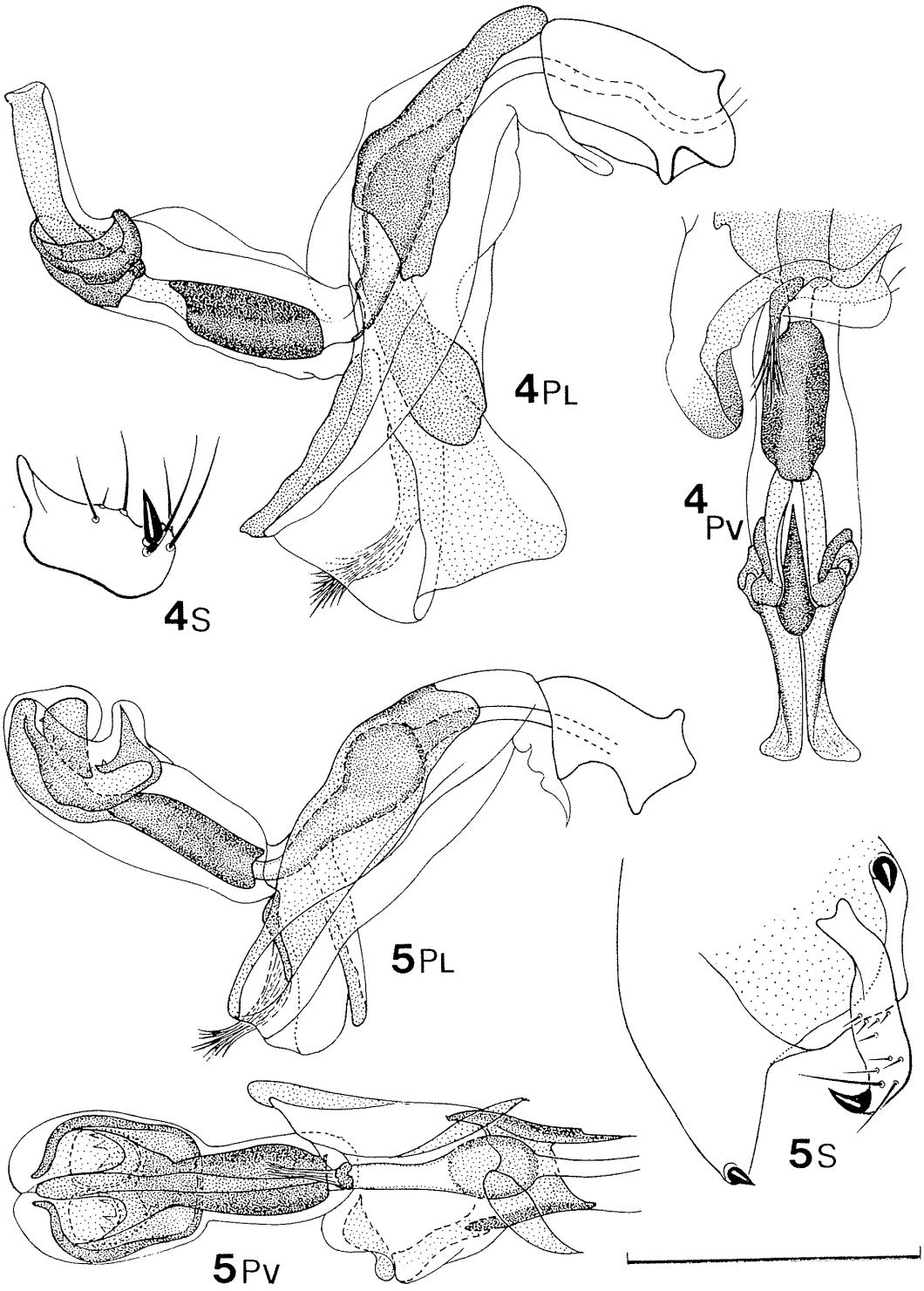

Fig. 4. *Liriomyza yasumatsui* SASAKAWA.
Fig. 5. *Liriomyza ptarmicae* DE MEIJERE.

Specimens examined. HOKKAIDO—2 ♂, from larvae on *Artemisia montana* PAMP., Sapporo, emerged 22. & 30. VII. 1985 (A. IWASAKI). HONSHU—1 ♀, from larva, 1. IX. 1990 on *Artemisia princeps*, Hachibuse, Kyoto, emerged 19. IX. 1990 (T. IMURA).

Distribution. Europe; Japan (Hokkaido, Honshu). New to Japan.

4. *Liriomyza yasumatsui* SASAKAWA

(Fig. 4)

Liriomyza yasumatsui SASAKAWA, 1972, 69.

This species has been known only from a male from Taiwan. The male from Japan has the genitalia which are virtually identical with those of the holotype, but the wing is long, 1.3–1.5 mm in male and 1.6 mm in female, the gena is broad (1/3 height of eye), the mesonotum is more densely pollinose and weakly shining, the mesopleuron is provided with a pale brown spot (minute and indistinct in female) at middle of ventral margin, and the ultimate section of M_{3+4} is just thrice as long as the penultimate.

The male genitalia are specific in having the tubulous distiphallus which is distinclty separated from the mesophallus and unexpanded ejaculatory apodeme (105–115 μm in length, 75–100 μm in greatest width).

The larval host plant, *Artemisia princeps* PAMP., was confirmed for the first time. The leaf-mine is ophionome; pupation externally; posterior spiracles of puparium each with 3 bulbs; a pair of tubercles on last abdominal segment projected distinctly.

Specimens examined. HONSHU—1 ♂ 2 ♀, from larvae, 2. X. 1990 on *Artemisia princeps*, Kamigamo, Kyoto, emerged 23–25. X. 1990 (T. IMURA); 4 ♀, from larvae, 2. X. 1990 on *A. princeps*, Takaragaike, Kyoto, emerged 21–25. X. 1990 (T. IMURA); 4 ♂, from larvae, 23. & 30 X. and 6. XI. 1990 on *A. princeps*, Shimogamo, Kyoto, emerged 11–16. IV. 1991 (T. IMURA): 2 ♀, from larvae, 16. X. 1991 on *A. princeps*, Shimogamo, Kyoto, emerged 30–31. V. 1992 (T. IMURA); 3 ♂ 1 ♀, from larvae, 17. & 22. XI. 1990 on *A. princeps*, Kibune, Kyoto, emerged 13–15. IV. 1991 (T. IMURA).

Distribution. Taiwan; Japan (Honshu). New to Japan.

5. *Liriomyza ptarmicae* DE MEIJERE

(Fig. 5)

Liriomyza ptarmicae DE MEIJERE, 1925, 286 & 291.
Liriomyza millefolii HERING, 1927, 185; SPENCER, 1976, 263.
Liriomyza chrysanthemi HERING, 1956, 116; SPENCER, 1976, 263.
Liriomyza pilosa SPENCER, 1969, 182; 1981, 259.

This species is characterized by the long pile on the third antennal segment

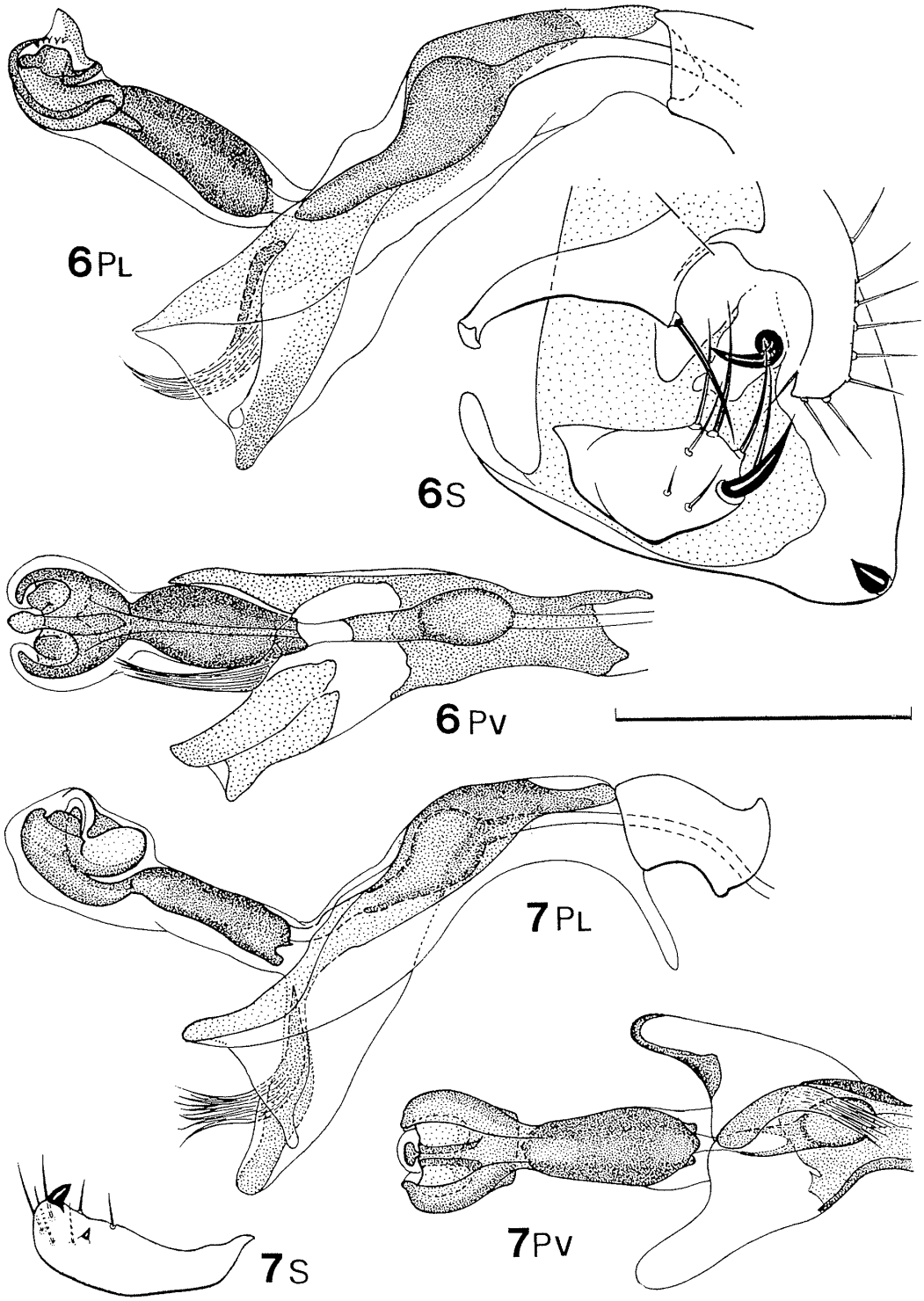

Fig. 6. *Liriomyza vitrimentula* n. sp.
Fig. 7. *Liriomyza katoi* SASAKAWA.

which is entirely yellow or distinctly brownish-darkened, shiny black mesonotum, projecting posteroventral corners of epandrium and narrow surstylus. The wings are 1.4–1.6 mm long in males and 1.7–1.8 mm in females.

The known larval host plants are *Achillea*, *Artemisia* and *Chrysanthemum* spp. in Europe and U.S.A.

Specimens examined. HONSHU—1 ♂, from larva, 30. X. 1990 on *Artemisia princeps*, Shimogamo, Kyoto, emerged 23. IV. 1991 (T. IMURA); 1 ♂, from larva, 31. X. 1991 on *A. princeps*, Kibune, Kyoto, emerged 17. V. 1992 (T. IMURA); 2 ♀, from larvae, 27. XI. 1990 in *Chrysanthemum* sp., Shimogamo, Kyoto, emerged 25. IV. 1991 (T. IMURA); 1 ♂, Sugikitamachi, Hirakata, Osaka Pref., 10. IX. 1989 (M. SASAKAWA).

Distribution. Europe; Canada, U.S.A.; Japan (Honshu). New to Japan.

6. ***Liriomyza vitrimentula*** n. sp.

(Fig. 6)

Male. Head including antenna and palpus bright yellow; ocellar triangle black; black of occiput extending laterally to dorsal postorbits but not reaching to base of *vte*; both *vt* on yellow vertical angle; arista brown, third antennal segment rarely brownish around base of arista. Mesonotum brilliantly shining brownish black, very sparsely pollinose when viewed from front, with a pair of yellow patches on posterolateral corners; both *pa* and *prs* at edge of dark area, the former rarely at edge of yellow patch; scutellum bright yellow, basal *sc* usually at edge of black triangle; mesopleuron entirely yellow, rarely with an indistinct, brownish spot at middle of ventral margin; sterno- and hypopleura each with a small, pale brown triangle ventrally; calypter with margin and fringe dark brown; legs largely yellow, mid and hind tibiae distally brown tinged, all tarsi faintly tinged with brown. Abdomen shiny brown to dark brown, tergites indistinctly yellowish on lateral sides and along posterior margins; cercus yellowish.

Frons 1.5 (rarely 2) times width of eye, converging ventrally; parafrontalia linearly projecting above eye-margin in profile, bearing two reclinate *ors*, two incurved *ori*, second *ori* very short, and a row of *oh*; eye higher than broad; gena 1/4–1/5 height of eye; *pm* 3–5; third antennal segment a little wider than long, with long, white pile; arista slightly longer than width of eye, swollen on basal 1/5, pubescent.

Mesonotum with 1+3 *dc*, first and second *dc* very short, the former about 1/3 and the latter about 1/2 length of the third, second *dc* very close to suture, distance between second and third *dc* nearly 1/2 that between third and fourth; four rows of *acr*; *ipa* less than 1/3 of *opa*; mesopleuron with 3–5 dorsally directed setulae. Wing with costal sections in proportion of 2.6–3.4: 1: 0.7–0.8; r–m at or very slightly beyond middle of discal cell; ultimate section of M_{1+2} 8–10 times as long as the penultimate; ultimate section of M_{3+4} 2.7–3.0 times length of penultimate.

Fifth sternite 2.5 times as wide as long; S6 twice as long as S5 and slightly wider

than S5, incised at middle of posterior 1/3. Genitalia: Epandrium broadened ventrally, bearing a long spine on posteroventral corner and an extremely long, claw-like spine on small sclerite at middle of inner side; cercus with ventrodistal seta slightly longer than others; surstylus of moderate size, bearing an extremely long spine and long or short setae; hypandrium narrowly U-shaped; postgonite 3/4 length of hypandrium; phallus with basiphallus and ventral process well developed, distiphallus divided into two parts, distal lobe eyeglass-like before end in ventral view; ejaculatory apodeme 195 (185–205) μm long, well expanded, 200 (185–225) μm in greatest width, basal bulb with a pair of semicircular sclerites.

Length of body 1.2–1.3 (holotype) mm, of wing 1.2–1.6, 1.5 (holotype) mm.

Female. Similar to male, but T6 with posterior margin distinctly yellow; ovipositor sheath shiny black. Genitalia: Egg guide 70 μm long, suboval, weakly sclerotized along lateral margin; T9 202 μm long; S9 140 μm long, with five *nsm*; cercus with six *ts* which are about 1/6 length of cercus; spermathecae suborbicular, with notch ventrally, 50×45 to 60×50 μm; neck 7 μm long; ventral receptacle pale brown, with distal tubule 20 μm in length.

Length of body 1.4–1.5 mm, of wing 1.6–1.8.

Puparium. Brownish yellow, 1.4–1.6 mm long; anterior spiracles each with 6–8 bulbs, posterior spiracles each with three bulbs; a pair of brown tubercles on last abdominal segment distinct.

Holotype male, from larva, 25. X. 1990 on *Artemisia princeps* PAMP., Kibune, Kyoto, emerged 8. V. 1991 (T. IMURA) (KPU No. 258). Paratypes: HONSHU—1 ♀, from larva, 28. VI. 1990 on *A. princeps*, Kibune, emerged 12. VII. 1990 (T. IMURA); 1 ♀, from larva, 1. IX. 1990 on *A. princeps*, Hachibuse, Kyoto, emerged 19. IX. 1990 (T. IMURA); 6 ♂ 1 ♀, from larvae, 28. VIII. 1990 on *A. princeps*, Kibune, emerged 8–9. IX. 1990 (T. IMURA); 1 ♂, from larva, 27. IX. 1990 on *A. princeps*, Kibune, emerged 17. X. 1990 (T. IMURA); 1 ♂, same data as holotype; 2 ♀, from larvae, 25. X. 1990 on *A. princeps*, Kibune, emerged 3. XII. 1990 (T. (IMARU; 2 ♂ 2 ♀, from larvae, 22. XI. 1990 on *A. princeps*, Kibune, emerged 11–13. & 28. IV. 1991 (T. IMURA); 1 ♀, from larva, 19. VIII. 1991 on *A. princeps*, Kibune, emerged 31. VIII. 1991 (T. IMURA); 5 ♂ 2 ♀, Hodani, Hirakata, Osaka Pref., 24. IX. 1989, swept on *A. princeps* (M. SASAKAWA); 1 ♂, from larva, 14. X. 1981 on *A. princeps*, Maegasaki, Matsudo, Chiba Pref., emerged XI. 1981 (K. OKAZAKI). HOKKAIDO—1 ♀, from larva on *A. montana*, Sapporo, emerged 1. VII. 1985 (A. IWASAKI).

Distribution. Japan (Honshu, Hokkaido).

Remarks. Despite the apparent similarity of this species to *L. katoi*, the male genitalia, including epandrium and surstyli, are easily distinguished between two species; in *vitrimentula*, spine on inner side of epandrium claw-like, with tip directed anteriorly, spine on surstylus longer than width of surstylus, distal portion of distiphallus projecting dorsally in profile, while in *katoi*, epandrial spine straight and directed inwardly, surstylus normally with one large and one minute spines, distal

lobe of phallus with vacuolate swelling on dorsal side before end.

7. *Liriomyza katoi* SASAKAWA

(Fig. 7)

Liriomyza katoi SASAKAWA, 1961, 400.

Phallus and surstylus of male genitalia as in Fig. 7; characteristic in structure of distiphallus.

Specimens examined. HONSHU—1 ♀, from larva, 20. X. 1990 on *Artemisia princeps*, Ohiwa, Kyoto, emerged 28. IV. 1991 (T. IMURA); 1 ♂ 1 ♀, from larvae, 25. X. and 17. XI. 1990 on *A. princeps*, Kibune, Kyoto, emerged 19. IV. and 5. V. 1991 (T. IMURA); 1 ♀, from larva, 4. XI. 1991 on *A. princeps*, Mt. Hiei, Kyoto, emerged 14. V. 1992 (T. IMURA).

Distribution. Japan; Malaysia.

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2) See the references in Parts 1–2 of this series.